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Ultra-broadband compression mirrors with double-angle technology (design PC70)

Our PC70 mirrors are optimized for chirp compensation with more than an octave spectral bandwidth, for example for compression of white light from a hollow core fiber. Conventional broadband chirped mirror designs compensate phase oscillations by combining two mirrors with complementary coatings, but the approach suffers from the additivity of manufacturing variations in the two coating runs. We have optimized our PC70 design instead to compensate phase oscillations by using identical mirrors from the same coating run at two different incidence angles.[1] The technique not only minimizes the influence of manufacturing tolerances, but also provides fine-tuning flexibility.

Specifications

- Bandwidth: 500-1050 nm
- Reflectance: > 99 % per bounce
- Supported pulse duration: < 5 fs (with appropriate input spectrum)
- Angle of incidence: 5°, resp. 19°
- Substrates: 1" diameter, FS, surface flatness λ/10 at 633 nm
- Database link: www.ultrafast-innovations.com/index.php/database/article/160-pc70

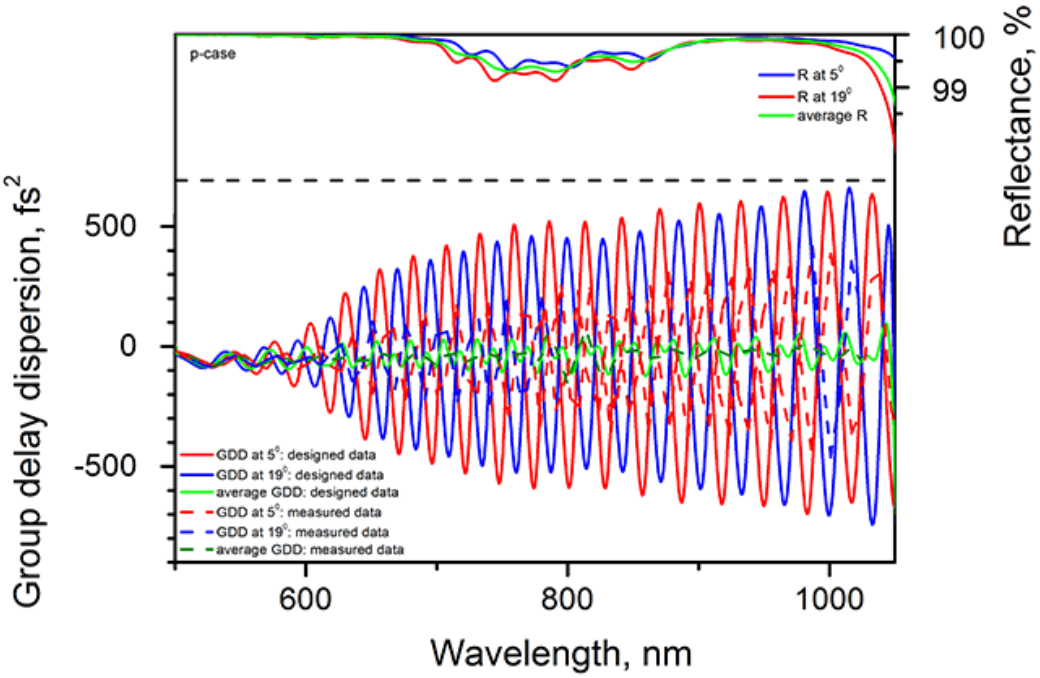

Figure 1: Dispersion (bottom panel) and reflectivity (top panel) properties of a mirror pair. The respective dispersion per bounce for 5 degree (red) and 19 degree incidence angle, as well as the average per pair (green), is shown. Solid lines denote theoretical values, dashed lines denote measured values.

Compression measurement

A typical application for our PC70 mirrors is the compression of a hollow core fiber output to the few-cycle regime. In the current example the output of an argon-filled hollow core fiber was compressed with PC70 mirrors to 3.2 fs, corresponding to 1.3-cycle pulses at 740 nm.[2] For GDD fine tuning a combination of BK7 wedges and a water cell was used, and the spectral phase was characterized with d-scan. The measurement demonstrates simultaneous compression over the full spectral bandwidth.

Laser input

Femtolasers Compact Pro, 1 kHz repetition rate, 400 μJ, 25 fs

Continuum Generation in a Hollow Core Fiber

Argon fill gas, 1 bar pressure, 1 m length, 250 μm inner diameter

PC70 mirror compressor

14 reflections, GDD fine-tuning with BK7 wedges, TOD fine-tuning with a water cell characterization with d-scan

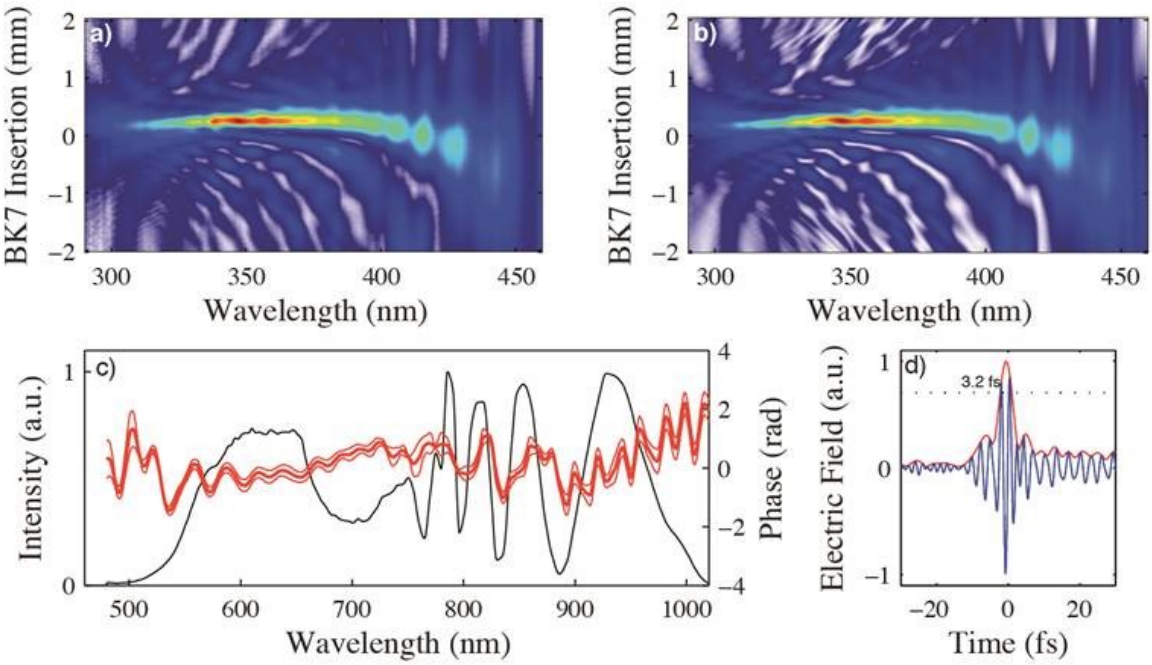

Figure 2: Single-cycle hollow-fiber compressor: Measured (a) and retrieved (b) d-scan traces. (c) Measured spectrum (black) and retrieved spectral phase with standard deviation (red). (d) Retrieved temporal profile for the wedge insertion that minimizes the pulse duration, corresponding to 3.2 fs (1.3 cycles at 740 nm).

Literature

[1] V. Pervak, I. Ahmad, M. K. Trubetskov, A. V. Tikhonravov, F. Krausz, *Opt. Expr.* **2009**, *17*, 7943.
[2] F. Silva, M. Miranda, B. Alonso, J. Rauschenberger, V. Pervak, H. Crespo, *Opt. Expr.* **2014**, *22*, 10181.